To overcome this difficulty we applied method (4b) (Fig. 2). As object-holder we used a 0.5μ Al-foil. The

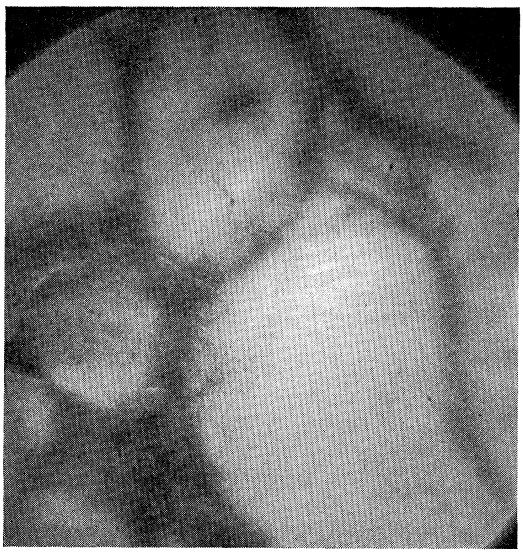

FIG. 2. Seaweed on Al-foil. × about 500.

osmium-impregnated tissue does not give in that case a picture of the same sharpness as Fig. 1, but we can distinguish the nucleus in some cells.

Besides the enumerated four methods to preserve cells from destruction there is a fifth: By diminishing the exposure there must be a limiting exposure-time, below which the cells are not destroyed. In other words, we might try to photograph the cells before their destruction.

We are constructing now a new microscope which will allow us to take instantaneous microphotographs (for instance: enlargement of 10,000 times in a 1/100 sec.).

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August 7, 1934.

[1] Martin, Nature **133**, 911 (1934); Bull. acad. Belgique **20**, 439 (1934).

Attempts to Detect the Emission of Deutons in Nuclear Transmutations

The impact of alpha-particles on nuclei is known to cause transmutations with emission of neutrons and protons. It has been suggested by F. Perrin[1] that emission of deutons is also likely, so this possibility must be considered in attempting to explain the various groups of emitted particles. The recent discovery of separate groups makes uncertain the conclusion reached by Rutherford[2] and Stetter[3] that all the heavy charged particles are protons, since they did not consider the properties of each group, but only those of the aggregate. We have, therefore, carried out magnetic deflection experiments on the disintegration products of boron and nitrogen to see whether the short range groups show any evidence for the presence of particles heavier than protons. At the same time we were able to verify directly that the particles produced by alpha-particles striking heavy hydrogen are deutons, as concluded by Rutherford and Kempton[4] from measurements of their range.

The experimental arrangement is a modification of Rutherford's original deflection apparatus. A lead block in an evacuated box prevents disintegration products moving in straight lines from entering half the window of a counting chamber. When the assembly is placed between the poles of an electromagnet, a field in one direction (designated as positive) bends paths around the block and into the counter. A field in the other direction (negative) bends paths away from the counter. A curve of numbers against the field was plotted for known protons (produced by bombardment of thin hydrogenous material by alpha-particles) and this was compared with corresponding curves for unknown particles. Account was taken of difference of initial velocity by selecting for counting (by stopping foils at the counter) particles having ranges between 3.0 cm and 9.0 cm after entering the magnetic field.

I. Projected particles from heavy hydrogen, in Ca $(OD)_2$

The results showed clearly that these particles were less easily deflected than those from hydrogen itself. Adjusting the ordinate scales to give the same maximum yield, the ratio of the experimentally found maximum slopes is 1.8 : 1 (protons to deutons) while the theoretically expected ratio is 1.7 : 1. The conclusion is that the particles from $Ca(OD)_2$ are deutons.

II. Particles from the disintegration of boron

The reaction

$$_5B^{10}+{}_2He^4={}_6C^{12}+{}_1D^2$$

seems to be most promising for deuton emission. Consideration of the mass defects shows that polonium alpha-particles could thus cause emission of a group of deutons of about 16 cm ranges. Bothe and Heidenreich found evidence of particles of about this range.

Deflection experiments were made on particles having between 8 cm and 14 cm total range. Natural protons from the source are present in this region, but the fact that the deflection proved to be as easy as for pure proton beams means there is no group of deutons comparable in number to the natural protons. The group found by Bothe and Heidenreich must therefore be protons.

III. Particles from the disintegration of nitrogen

Particular attention has been given to this by F. Perrin.[1] He suggests the reaction

$$_7N^{14}+{}_2He^4={}_8O^{16}+{}_1D^2$$

and predicts a deuton range of 7.2 cm for full range polonium alpha-particles. A repetition of his calculation with Bainbridge's value for the mass of the deuton shows this estimate to be rather high. Nevertheless, a careful preliminary search was made for a short range group besides the resonance group already known. Additional

evidence for a broad resonance level giving a group of yield approximately 0.4 that of the main group was found, but there was no sign of any second group of range greater than 4 cm produced by the full range alpha-particles.

In spite of this the magnetic deflection was tested. The minimum range entering the counter was reduced to 5 cm and a comparison made with protons from coal gas. The curves show a resonable agreement and the conclusion is that the short range products from nitrogen are principally protons.

Thus we have found no evidence of emission of deutons in polonium alpha-particle disintegrations of boron and nitrogen.

We wish to thank Professor A. F. Kovarik for his advice and help in discussion, Professor H. C. Urey for a gift of heavy water, and Dr. C. T. Lane for advice in running the magnet.

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[1] F. Perrin, C. R. **194**, 2211 (1932).
[2] Rutherford, Chadwick and Ellis, *Radiations from Radioactive Substances*, p. 290.
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[4] Rutherford and Kempton, Proc. Roy. Soc. **A143**, 724 (1934).
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The Absorption Spectra of Formaldehyde and Hydrogen Cyanide in the Far Ultraviolet

We have recently found a new absorption spectrum of formaldehyde in the region 1750–1150A. The absorption is very strong and most of the bands appear at a pressure of 0.1 mm in the spectrograph, the light path being about 1.5 meters. They consist mainly of two electronic series going to the same limit. About seven members of each series were found. The lower members are accompanied by many vibrational transitions. The higher ones can be extrapolated in the form of a Rydberg series to an ionization potential of 10.9 volts. This agrees very well with the value 11.3 ± 0.5 volts found by Jewitt[1] employing the usual methods of electron impact.

In this connection it is interesting to note the agreement between the limits of the electronic series in acetylene and ethylene[2] with the values for their ionization potentials as given by Tate and Smith,[3] and Kallman and Dorsch.[4] The values we obtain are 11.4 and 10.4 volts, respectively, which are in good agreement with the values 11.6 ± 0.1 and $10.0\pm?$ volts determined by the methods of electron impact.

The bands of formaldehyde show very strong predissociation in the region 1740A. If it is assumed that this is due to interaction with the initial state the process being $H_2CO\rightarrow H_2C+O$ we find the strength of the C=O bond to be 164 cal./mol. in fairly good agreement with thermochemical data.

The general similarity between the ultraviolet absorption spectra of acetylene, ethylene and formaldehyde is quite striking. They all have spectra in the region 3000A to 1800A which come out at fairly high pressures. They also possess spectra of an apparently different type having much higher transition probabilities below 1800A. These latter consist of electronic series going to the ionization potentials of the molecules.

The investigations on HCN revealed bands extending from 1450A to well below 1000A. The bands in the region 1400A are single headed and are shaded towards the red. They are given very well by the following formula

$$\nu=68{,}645+901(v+\tfrac{1}{2})-22(v+\tfrac{1}{2})^2. \qquad (1)$$

Slight predissociation sets in at the $v=4$ band. The same vibration pattern does not repeat itself in the bands at lower wave-length, the vibration frequencies being considerably larger. The latter bands are too diffuse to be analyzed thoroughly but it is probable that they form an electronic series going to the ionization potential of HCN at 14.8 volts. The bands given by (1) come out at somewhat higher pressures than those at lower wave-lengths. This indicates that here again we have the two types of absorption found in the previously mentioned molecules.

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August 11, 1934.

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Surface Magnetization in Ferromagnetic Crystals. II

We reported in a recent Letter to the Editor[1] certain peculiarities of the surface magnetization of a single crystal of silicon iron, the polished face of which was not much inclined to a plane of form {100}. In order to explain the maze-like pattern of narrow lines formed by temporary condensation of a magnetic colloid close to this surface, and the enhancement of alternate lines of the maze by normal magnetic fields of the two possible signs, we had to suppose that the surface consisted of small blocks (possibly cubes) of square section, magnetized parallel to the surface along axes of form <100> and <110>, the former being preferred. These two directions are, respectively, directions for easiest magnetization and for next-to-easiest magnetization in single crystals of silicon iron.

It occurred to us that the patterns obtainable on a {100} plane in nickel should be different from those found in iron; for even if the surface still broke up into square blocks, all directions of easiest magnetization—here of form <111>—would now lie at 35° to the polished surface. After some optical difficulties occasioned by the smaller scale of the patterns developed on a suitable polished disk cut from a single nickel crystal,[2] we are able to show that conditions are, indeed, different from those in silicon iron. Fig. 1 gives two pictures of the same region with normal magnetic fields of opposite sign. The colloid particles collect in dots of various density which we find show best under slightly oblique illumination, so that each seems to cast a shadow.